August 30, 1973

Dear

Here is the first draft of the Statements of Work and Cost. My secretary put this on stationary because I forgot to mention to her that I was dictating for another party.

I would like to pitch to when he visits late in September. That might be worthwhile if you have a rather complete understanding of how he will address the scaling problem I mentioned and have an opportunity to dry run his presentation. Perhaps such a careful exposure would be good for the project's viability.

See you soon. Stay well and happy.

Sincerely,

PHASE I

ESTIMATING THE EFFECTIVENESS OF ELECTRIC FISH IN DETECTING FOREIGN OBJECTS AT A DISTANCE

Perform psychophysiological experiments using different kinds of electric fish in restricted water so as to estimate their ability to identify the existence of foreign objects in this water taking into account electrical discontinuities imposed by the boundaries of that water and the foreign objects placed within it. Specifically, consider the natural fish as a signal generator and receptor and then use of auxiliary signals which replicate the fishes signals and other signals of specific interest. Compute the expected behavior of such fish in open ocean or fresh waters given typical boundary conditions with respect to depth, topology, inogeneity of the water, temperature, and so forth. Summarize these findings in terms of the prospective ability of these fish to identify foreign objects in a harbor or other natural body of water of interest...foreign objects such as small submarines, torpedoes, scuba divers skin divers, and so forth.

More explicitly, determine the sensory capability of individual electric fish in terms of their ability to sense the existence of foreign objects as a function of range, fundamental area, volumetric displacement, differential discontinuity, and so forth. In this regard, use a tank of

water adjusted to the temperature and electrolytic conditions of presumed operational conditions. Retain a fish near one point and insert in the water various objects, discerning the different behavior of the fish as these objects are inserted concurrently monitoring the electrical field within the water. From these results, calculate the estimated behavior of such a fish in detecting an object in an infinite water domain and large scale waters with various boundary conditions.

PHASE II

DETERMINING THE METHODS USED BY ELECTRIC FISH FOR RANGING AND LOCATION

Perform detailed experiments wherein the particular characteristics of electric fish are related to their abilities with respect to ranging and location. Particular attention will be focused upon the use of phased arrays of receptors, the fish's ability to determine incremental time lags in the signal, the estimated spectral properties of the signal, to modify the transmitted signal as a reflection of knowledge gained from previous receptions, and so forth. Interpret these findings in terms of specific schematics and data analysis required to synthesize models of the fish's capability, models which when reified would provide signal advantage over the state of the art with respect to such a target as described above.

PHASE III

DESIGN OF EQUIPMENT SYSTEMS SUITABLE FOR REPLICATING ELECTRIC FISH IN TERMS OF TARGETING FOREIGN OBJECTS

Design, fabricate and test experimental apparatus suitable for replicating the above referenced models. Perform experiments with this apparatus so as to improve its ability in various regards. Make a specific comparison of this capability to that of an electric fish and estimate the utility of such an apparatus in terms of operational situations.

STATEMENT OF COST

PHASE I - $ - 6 months

PHASE II - $ - 1 year

PHASE III - $ - 1 year